A SIMPLE AND INEXPENSIVE METHOD FOR POLAROID PROJECTION OF STEREO SLIDES

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A SIMPLE AND INEXPENSIVE METHOD FOR POLAROID PROJECTION OF STEREO SLIDES

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ABSTRACT

Projection of three-dimensional images to illustrate research results is receiving increased attention at many scientific meetings. However, the projector generally used for this purpose is unavailable at many research laboratories and institutions, is cumbersome to transport, and must be operated manually. This paper describes a simple and inexpensive procedure by which two Kodak Carousel or Ektagraphic projectors are easily modified into a Polaroid stereo projection system. The modification, which requires 10 minutes and costs $0.25, consists of orienting two Polaroid filters on the front lenses of two Kodak projectors. The two projectors are positioned side by side to produce the stereo projection system.

In addition to the low cost of the filters that are required and the convenient use of commonly available projectors, this projection system provides several advantages not found on the standard stereo projector but normally associated with the Kodak projectors: (1) Carousel trays that allow a speaker to properly load and orient slide pairs before a presentation; (2) remote control units that advance, reverse, and focus slides and that can be easily operated by either the speaker or the projectionist; (3) 300-watt projection lamps that are universally available and easily replaced and that produce bright screen images; and (4) slide prewarming that helps eliminate dust and prevent "popping."

In addition to a description of the projector modification, this paper contains information needed for obtaining and orienting Polaroid filters, for mounting slide pairs, and for properly alining and remotely controlling the two projectors. Although these procedures are described for Polaroid stereo projection, the same principles and advantages are realized when suitable filters are used to project anaglyphs with two projectors. As a result, low cost stereo projection systems, either Polaroid or anaglyph, can be created by any person or at nearly any meeting or location where the standard stereo projector is unavailable.

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INTRODUCTION

The tilting stage, a standard feature of most scanning electron microscopes, allows investigators to photograph the secondary electron image of a specimen at different angles. Placing a pair of these photographs, consisting of a right and a left image that generally differ by 5 to 10°, under a stereo viewer allows the investigator to perceive a reconstructed three-dimensional image (stereopsis) of the specimen. As a result, insights into the structural relationships of the specimen are frequently greater.

Information obtained from a three-dimensional analysis of a specimen in the laboratory is difficult to share with colleagues at a meeting or to illustrate in a teaching situation because of the relative unavailability and complexity of stereo projectors. A stereo projector manufactured in England has gained greatest acceptance and is used at a few professional laboratories and at meetings of societies where three-dimensional microscopy is discussed. However, this projector has several disadvantages: (1) The instrument is relatively expensive. The latest model costs about $800; therefore, it is not commonly found in laboratories or institutions unless three-dimensional investigations have been seriously undertaken; (2) the projector weighs 34 pounds and is stored in a box 24 by 10 by 15 inches and thus is difficult to transport; and (3) the projector must be manually operated. Therefore, slide changing, focusing, and lateral and horizontal alinement of stereo pairs are performed by either the speaker or the projectionist who must be given rudimentary instructions on the use of the projector.

Recent experience with this projector has resulted in a search for alternative procedures that could be used to project three-dimensional slides. This paper describes how two standard Kodak Carousel or Ektagraphic projectors can be modified for stereo projection. The modification requires 10 minutes and costs about $0.25. The result of this modification is a superior Polaroid stereo projection system that can be set up at any institution or university where Kodak projectors are availabe and could greatly enhance the future use of three-dimensional projection as a research and instructional tool.

PROJECTOR AND FILTER CONSIDERATIONS

The principle of producing three-dimensional illusions with Polaroid filters is diagrammatically summarized in figure 1. The standard stereo projector commercially available incorporates two lamps, filters, and lenses into a single instrument. However, the same effect can be easily produced by adding two Polaroid filters to two separate projectors. The following description refers to Kodak Carousel or Ektagraphic projectors because they are most commonly available, give consistent vertical slide alinement, and are easily matched for screen brightness and focal lengths.

To produce a balanced stereo illusion, the right and left images should have similar screen brightness. This is not a serious problem when the Kodak projectors are used. Even though older models are equipped with 500-watt projection lamps and current models are supplied with 300-watt lamps, both types project similar screen brightness because improvements in the bulb design and reflector system have increased the efficiency of the 300-watt lamp.

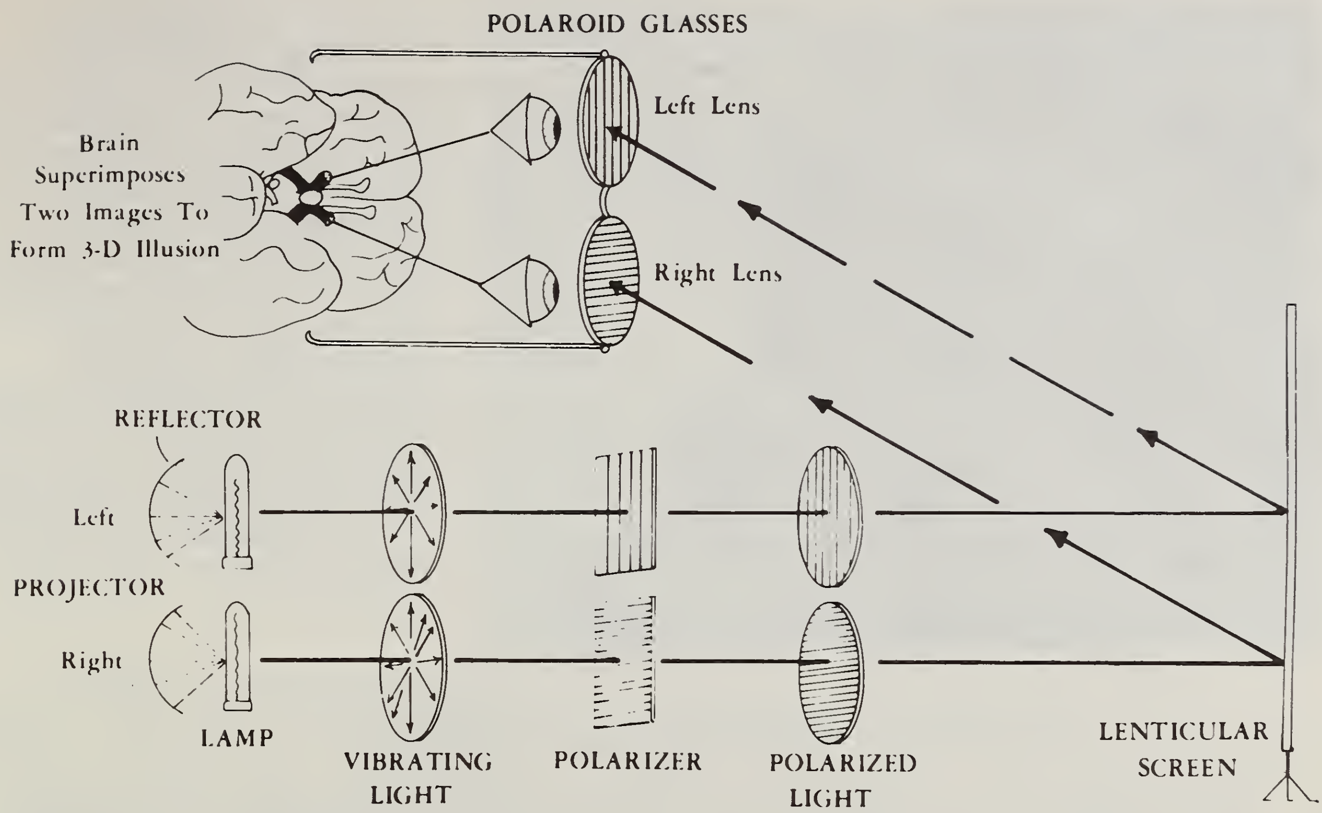

Figure 1.--Diagrammatical summary of three-dimensional image formation using Polaroid filters.

Minor variation in screen brightness attributed to differences in either the ages of the projection lamps or the optical properties of the heat-absorbing filters in the Kodak projectors does not appear to significantly affect stereopsis.

Focal lengths of the lenses must be matched if the projectors are to be mounted on the same stand at equal distances from the viewing screen. Kodak Carousels are equipped with either a Ektanar C 102-mm, 127-mm, or Zoom 102- to 152-mm lens. Consequently, the two projectors must be matched with either two 102-mm's, two 127 mm's, or at least one Zoom that can be adjusted to match the fixed focal length of any of the other lenses.

Polaroid filter material is available in a variety of sizes, densities, and forms. Twenty 2- by 2-inch filters can be obtained from Edmund Scientific for $2.50.2/ These filters are large enough to cover the front of most projector lenses and stable enough to prevent rapid depolarization from the heat and light generated by the projector.

The left and right lenses from a pair of Polaroid stereo viewing glasses may also serve as suitable filters for short periods of time. However, these filters are generally of poor quality and are more sensitive to depolarization.

2/ Edmund Scientific, 7777 Edscorp Building, Barrington, N.J. 08007; 2"x2" Polarizing Filters, package of 20, No. P-41,168; $2.50 prepaid.

Figure 2.--Determining orientation of Polaroid filter that is to be mounted on a projector. The intensity of light is observed as it passes through the projection lens, the Polaroid filter, and the viewing glass lens from a pair of horizontally held glasses. As the filter is rotated, minimum light transmittance indicates that the Polaroid materials in the filter and in the viewing lens are at right angles to one another.

PROJECTOR ALINEMENT AND FILTER ORIENTATION

Before the Polaroid filters are mounted, the projectors are placed side by side and alined so that the focused image emitted from the right projector is horizontally and vertically superimposed on the image produced by the left projector. If one projector is equipped with a Zoom lens, the lens is first adjusted to throw a focused image equal in size to that produced by the other projector. Projectors that are placed side by side at short distances from the viewing screen produce skewed images that cannot be superimposed. Under these circumstances, the use of a piggyback stand, which can be easily constructed or purchased,3/ decreases the distance between the projector lenses and helps eliminate this problem.

After the images are alined, the Polaroid filters are taped to the front of each projector lens so that the orientation of the Polaroid material mounted on the left and right projectors is the same as that in the left and right lenses of a pair of stereo viewing glasses. To obtain the proper orientation, switch on the right projector lamp, hold a Polaroid filter in front of the projector lens, and position the right lens of a horizontally held pair of viewing glasses 1 to 3 inches in front of the filter (fig. 2). While observing the intensity of light that is passing through the projector lens, unoriented filter, and viewing glass lens, rotate the filter until optimum transmittance of light is perceived. At that orientation, tape the filter to the projector lens. (Alternatively, rotate the filter for the right projector behind the left viewing lens to determine minimum transmittance, i.e., no light). A similar procedure is used to orient the filter for the left projector. If either projector is equipped with a Zoom lens, the lens should not be rotated after projector alinement and filter orientation have been determined.

3/ Kodak AV Equipment Memo. Piggyback stand for two-screen or dissolve projection with two Kodak slide projectors. Kodak Pamphlet No. S-55. Eastman Kodak Co., Rochester, N.Y. 14650.

SLIDE MOUNTING

The standard stereo projector enables the projectionist to adjust the vertical and horizontal alinement for each stereo pair. When two independent projectors are used, vertical alinement, which is most critical for perceiving stereopsis, must be corrected with the elevation screw located in the front of the Kodak Carousels. To aline the images horizontally, swivel one of the projectors to regain superimposition of the stereo pairs. However, if stereo slide pairs are mounted carefully, alinement need not be adjusted vertically or horizontally during a three-dimensional slide presentation.

To facilitate alining and mounting, print the slides for stereo projection on a transparency film that can be easily cut or trimmed. Images printed on Kodak Projector Slide Plates, which are frequently used for electron micrograph projections, cannot be alined by this procedure. The following films have been found suitable: Polaroid, Type 147 Film, which produces positive transparencies from positive prints, and Kodak Commercial Film 6127 or Fine Grain Positive Film 7302, which produce positive transparencies from negatives.

Commercial jigs are available to assist with the alining and mounting of stereo slide pairs.4/5/ However, slides have been properly alined simply by using a light box. The procedure consists of framing and mounting one of the transparencies with a 35-mm mask in a 2- by 2-inch frame. This mounted slide is placed on a back-lighted surface, and a second mask and the remaining transparency are placed to coincide with the mask and image in the mounted slide. In this position, tape the transparency to the mask, trim as necessary, and mount in a second 2- by 2-inch frame. This procedure generally produces stereo pairs that enable the viewer to perceive good stereopsis without having to adjust previously alined projectors.

SLIDE TRAYS AND REMOTE CONTROL UNITS

Using two slide projectors, such as the Kodak Carousels or Ektagraphics as opposed to the commercial stereo projector, allows a speaker to use preloaded slide trays and remote control units. Both of these features offer distinct advantages.

Sixty-four combinations exist for placing two slides in the manual stereo projector. Although four combinations may be satisfactory, only one is correct. Slide trays enable the speaker to properly orient and lock the slides in place prior to attending a meeting. This procedure eliminates slide insertion errors by a projectionist during an oral presentation.

4/ Polysciences Inc., Paul Valley Industrial Park, Warrington, Pa. 18976; mounting jig for stereo slides, catalog number 3581.

5/ Producing and binding slides for dissolve projection. Pamphlet No. S-15-26. Eastman Kodak Co., Rochester, N.Y. 14650.

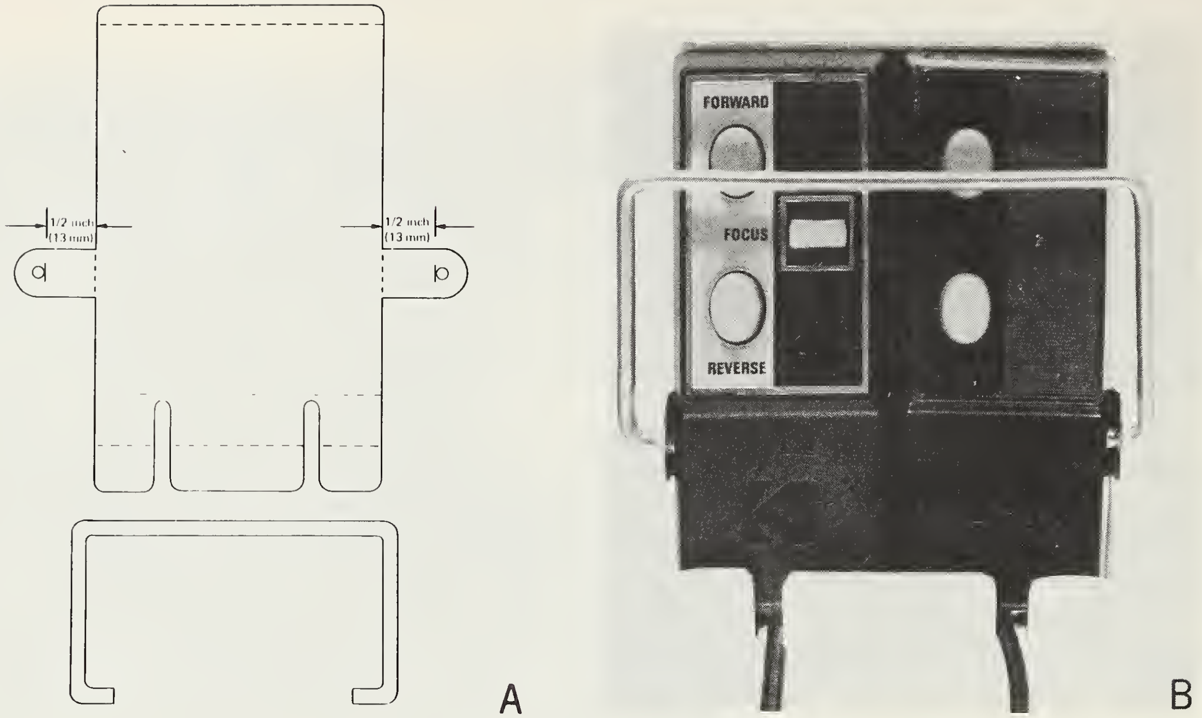

Figure 3.--Pattern (A) for a clip that will form a holder (B) for two Kodak remote control units. (Figure 3A is reproduced from Kodak Periodical No. T-91-6-1.)

The remote control units commonly used with Carousels or Ektagraphics allow the speaker to advance, reverse, and focus the projectors. To free one hand, a speaker may want to use a clip (fig. 3) that will hold two Kodak EC Remote Control Units.6/ This clip allows single hand control of slide advance. As a result, the need for a speaker either to operate the standard stereo projector during the presentation or to give rudimentary instructions on the use of that instrument to a projectionist is eliminated.

ANAGLYPH PROJECTION

As an alternative to polarized light, the anaglyph method can be used to project stereo pairs. Kodak Carousels or Ektagraphics could be modified for this projection method by substituting red and green filters for the Polaroid filters.7/ The 2- by 2-inch slides are alined, mounted, and projected in a manner similar to that described for the polarized light system. However, for anaglyph projection, an ordinary glass beaded screen can be substituted for the lenticular or silver screen that is essential for perceiving stereopsis by the polarized light method.

6/ Audiovisual Notes from Kodak. How to control multiple slide projectors with one hand (tied behind your back?). Kodak Periodical No. T-91-6-1, p. 8. Eastman Kodak Co., Rochester, N.Y. 14650.

7/ Ledbetter, M. C., W. J. Geisbusch, W. R. McKinney, and P. S. Woods. Anaglyph electron micrographs. I. Prints and projection. Electron Microscopy Society of America Bulletin 7(2):21-27. 1977.

CONCLUSIONS

The modified Kodak projector system described in this paper appears to be an efficient and economical procedure that achieves three-dimensional imaging by a light polarization method. It is hoped that this system will encourage wider application of stereo projection in research and in teaching situations.

ACKNOWLEDGMENT

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